The Norwegian Government is to be asked to take responsibility for, and bear the expenses of, the administration of the Herring Committee. The program of researches on herring is divided into eleven groups, which have been allotted to different nations. England is to take a special interest in the collection of statistics, investigation of younger stages of herrings and their distribution, location and characteristics of spawning grounds, and hydrographical and biological observations where fishing is going on and in the spawning grounds. Scotland, which has a deep interest and special opportunities, is to take a share in all the sections of the herring program.

There has been a similar distribution of the researches to be undertaken with regard to cod and haddock. England is to take her share in practically all the sixteen sections of the program, but is to hand over English haddock statistics to be dealt with by Scotland, and in return is to deal with the Scottish cod statistics.

The Atlantic Slope Committee is to investigate the hydrography and biology of the Atlantic Slope area from Gibraltar to Rockall. The work is to be shared by England, Scotland, Ireland, France and Portugal, and is to be carried out chiefly by regular cruises undertaken by research vessels.

Work on plaice has been going on for twenty years, Great Britain having taken a lead in it, with great help from Denmark and Holland, and from Germany before the war. There have also been valuable independent investigations made more recently by Germany. The recommendations adopted by the council were in effect those suggested by the committee.

The council agreed that there was clear evidence as to the possibility of serious depletion of plaice fisheries by fishery operations, and that such had actually taken place before the war. The forced restriction of fishing during the war had been followed by a large increase in average size and in numbers, but there is already evidence of a decline of the stock resulting from the resumption of intensive fishing. This decline is likely to be progressive; protective measures will become necessary in the near future. They recommend, therefore, the prohibition of fishing by steam trawlers and motor vessels of more than 50 h.p. throughout the year along a zone from the Continental coast to the 12-fathom line from about the Hook of Holland to the middle of Denmark, and, except during the months of April, May and June, to a 15-fathom line from Heligoland to the northern limit of the inner zone.

They suggest that measures of restriction should be reviewed three years after their inception, and point out that, although it is a matter for consideration by individual governments, the enforcement of restrictions will be difficult without the sympathetic cooperation of the trade. Finally, they urge a method of improving the fisheries suggested many years ago by Professor Garstang—the transplantation on a very large scale of small plaice from regions where they are overcrowded, to regions such as the Dogger Bank, difficult to reach by natural migration, and yet affording an abundant supply of food and suitable conditions for rapid growth.

The British delegates call special attention to the need of securing the cooperation of the British fishing industry, and advocate a preliminary discussion of the administrative aspects of the question by representatives of the departments concerned, the Admiralty and the Board of Trade, to be followed by conference with the industry. They also point out that when the government had come to a conclusion as to what measures they were prepared to advocate, there should be further conference with the other governments concerned, including Germany.

## SPECIAL ARTICLES

### CRITICAL POTENTIALS OF THALLIUM VAPOR

THE only published results of direct measurement of critical potentials for elements of the third column of the periodic table are the data on thallium vapor obtained by two of the authors[1] several years ago. The measurements given in Table III and Fig. 3, *l.c.,* showed inelastic collisions without ionization at intervals of 1.07 $\pm$ .1 volts and ionization at an *applied* potential of 6.6 volts. At that time the 1.07 volt impact was thought to be related to the infra-red line $\lambda$ 11513 here designated as $2s—3p_2$. After correcting the 6.6 volt impact for initial velocity, the value 7.3 volts

[1] Foote and Mohler, *Phil. Mag.,* 37, p. 33, 1919.

TABLE I.

| Volts | Excitation Transition | Radiation Transition | Wave-length emitted |
|---|---|---|---|
| 0.962 | $2p_2 \rightarrow 2p_1$ | None | |
| 3.269 | $2p_2 \rightarrow 2s$ | $\left\{ \begin{array}{l} 2s \rightarrow 2p_2 \\ 2s \rightarrow 2p_1 \end{array} \right.$ | 3776 A<br>5350 |
| 4.47 | $2p_2 \rightarrow 3d_{1,2}$ | $\left\{ \begin{array}{l} 3d_2 \rightarrow 2p_2 \\ 3d_1 \rightarrow 2p_1 \\ 3d_2 \rightarrow 2p_1 \end{array} \right.$ | 2768<br>3519<br>3529 |
| 6.082 | $2p_2 \rightarrow \infty$ | Arc spectrum | |

was obtained for the ionization potential, which corresponded to no known series limit. These data are inconsistent with the new Bohr theory of atomic structure, and for this reason it has been suggested[2] that a redetermination of the critical potentials of thallium was highly desirable.

Thallium shows a doublet spectrum quite similar to the alkalis except that the highest wave number in the spectra of the latter is $1s$, while the highest known term for the metals of Group III is $2p_2$. Bohr's theory indicates that such a condition is to be expected and that $2p_2$ represents the normal state of the atom for these metals. Hence the ionization potential should be determined by this term. A recent paper by Grotrian[3] on the absorption spectra of thallium and indium has confirmed this view in a most conclusive manner.

We have redetermined the ionization potential of thallium by the Lenard method. The applied potentials were corrected (1) by measuring the velocity distribution of electrons and (2) by introducing mercury vapor and measuring the difference in the ionization potentials of the two elements. The two methods gave 6.02 and 6.1 volts respectively, with a weighted mean of 6.04 ± .1 volts. The limit $2p_2 = 49264$ corresponds to 6.08 volts in excellent agreement with the observed value.

Inspection of the previously published data shows immediately the source of error in the value of the ionization potential there given. The measured applied potential was corrected by comparison with the potential of the first inelastic collision. The first distinct point occurred at 1.55 volts, but in a single case[4] there was a slight indication of inelastic impact one volt lower. We concluded that this point was real, and that the distinct resonance at 1.55 was actually the second resonance collision. Our more precise recent experiments show that this faint inflection was due to an accidental variation in current, and it is unfortunate that we were misled in the interpretation of data, which, with this single exception, now appear to be fairly precise. Since actually the 1.55 volt collision, observed in our work of four years ago, is the first resonance point, the corrected ionization potential is readily seen to be 6.12 volts, a value entirely concordant with the more accurate work described above.

The resonance potential of 1.07 volts can not be ascribed to $\lambda$ 11513, $2s$—$3p_1$, as this line is now known to be neither a resonance line nor an absorption line for the normal atom. The smallest quantum of kinetic energy absorbable by the normal thallium atom in its $2p_2$ state corresponds to $\nu = 2p_2 - 2p_1, = 7793 \approx 0.96$ volts. This is, within the error of measurement, in agreement with the observed value 1.07 volts. We have accordingly a peculiar type of resonance potential[5] since, unlike the metals of Groups I and II, the resonance collision is not followed by the emission of the corresponding single-line spectrum. The emission of $\nu = 2p_2 - 2p_1$ is forbidden by the principle of selection for azimuthal quantum numbers. Hence collisions of this

TABLE 2

CRITICAL POTENTIALS FOR ALUMINIUM SUBGROUP (IN VOLTS)

| Element | Ionization | | Resonance Potentials | | |
|---|---|---|---|---|---|
| | $2p_2$ | $2p_1$ | $2p_2$—$2s$ | $2p_2$—$3d$ | $2p_2$—$2p_1$ |
| Al | 5.960 | 5.946 | 3.129 | 4.004 | 0.014 |
| Ga | 5.973 | 5.871 | 3.060 | 4.294 | 0.102 |
| In | 5.761 | 5.488 | 3.009 | 4.06 | 0.273 |
| Tl | 6.082 | 5.120 | 3.269 | 4.47 | 0.962 |

[2] "Origin of Spectra," Foote and Mohler, page 65.

[3] Grotrian, *Zeit. f. Physik.*, 12, p. 218, 1922.

[4] l. c., Fig. 3, curve 9.

[5] A somewhat similar phenomenon is exhibited by the lower resonance potential of helium.

type produce a metastable form of thallium.

In addition to this type of collision there should be at least two other resonance potentials and each of these will give rise to several lines in emission. Table I shows the probable stages in the excitation of normal thallium.

Metastable thallium, which Grotrian shows may be produced by heating to 800°C., should have resonance potentials about one volt lower, corresponding to $\nu = 2p_1 - 2s$ and $\nu = 2p_1 - 3d_{1,2}$.

One may now predict with certainty the critical potentials for other elements in this group as shown in Table II. Further work with these vapors is in progress.

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## CROSS-INOCULATION STUDIES WITH CUCURBIT MOSAIC

CONTINUED cross-inoculation studies with cucurbit mosaic have shown that the disease may be transmitted to nearly all species of the cucurbits and to a number of plants in families other than the cucurbitaceæ. The cross-inoculation experiments with the cucurbits, described in an earlier paper,[1] have been continued until we now have 8 genera, 23 species, 8 varieties and 96 horticultural varieties which are known to be susceptible to the disease. This list includes a number of species and varieties from Europe, Asia and Africa. With the exception of the genus *Citrullus,* all of the cucurbits thus far inoculated have proven susceptible to mosaic. Inoculations in this genus have included twenty varieties of watermelon and citron, but infection has been secured only in the case of the green-seeded citron,[1] which appears to be susceptible to the disease.

Cross-inoculations with plants of other families, as earlier reported, gave some evidence that cucurbit mosaic was transmissible to martynia *(Martynia louisiana),*[1] pepper *(Capsicum annuum),*[2] milkweed *(Asclepias syriaca),*[2] and pokeweed *(Phytolacca decandra).*[3] Further studies have shown that cucurbit mosaic is readily transmissible to these hosts and back to the cucumber. The disease has also been transmitted from milkweed to both martynia and pepper and back to the milkweed. The writers have found that the most uniformly successful method of inoculation consists in the transfer of aphids from a mosaic plant to the plant inoculated, but successful results have also been obtained by artificial inoculation with the crushed tissue or expressed juice of mosaic plants.

We have also found that cucumber mosaic is readily transmissible to tobacco through the pepper and *vice versa,* the pepper apparently acting as an intermediate host. Numerous direct inoculations from cucumber to tobacco have been unsuccessful up to the present. Elmer,[4] however, reports that he has secured infection on cucurbits inoculated with tobacco mosaic and *vice versa.*

A continuation of the earlier experiments with the potato[3] has shown that cucumber mosaic is apparently transmissible to this host. We have secured a high percentage of infection in several series of inoculations to the cucumber from potato plants which had earlier been inoculated with cucumber mosaic. Tubers from potato plants which were inoculated from the cucumber in 1921 developed symptoms of mosaic when grown in the greenhouse during the past winter. Experiments also indicate that potato mosaic may possibly be transmitted to the pokeweed. In the latter experiments the potatoes used were from mosaic stock secured in northern Wisconsin. These experiments are still in a preliminary stage, however, and are being continued at the present time. During the past summer it has been found that cucumber mosaic may also be transmitted to the pigweed (*Amaranthus retroflexus*) and to a cultivated ground cherry (*Physalis sp.*).

A complete report of this work is being submitted for early publication.

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1 *U. S. D. A. Bull.* 879, 1-69, 1920.
2 *Phytopathology,* 11, 47, 1921.
3 *Phytopathology,* 12, 42-43, 1922.
4 SCIENCE, 56, 370-373, 1922.